The Western Mediterranean Circulation Experiment (WMCE)

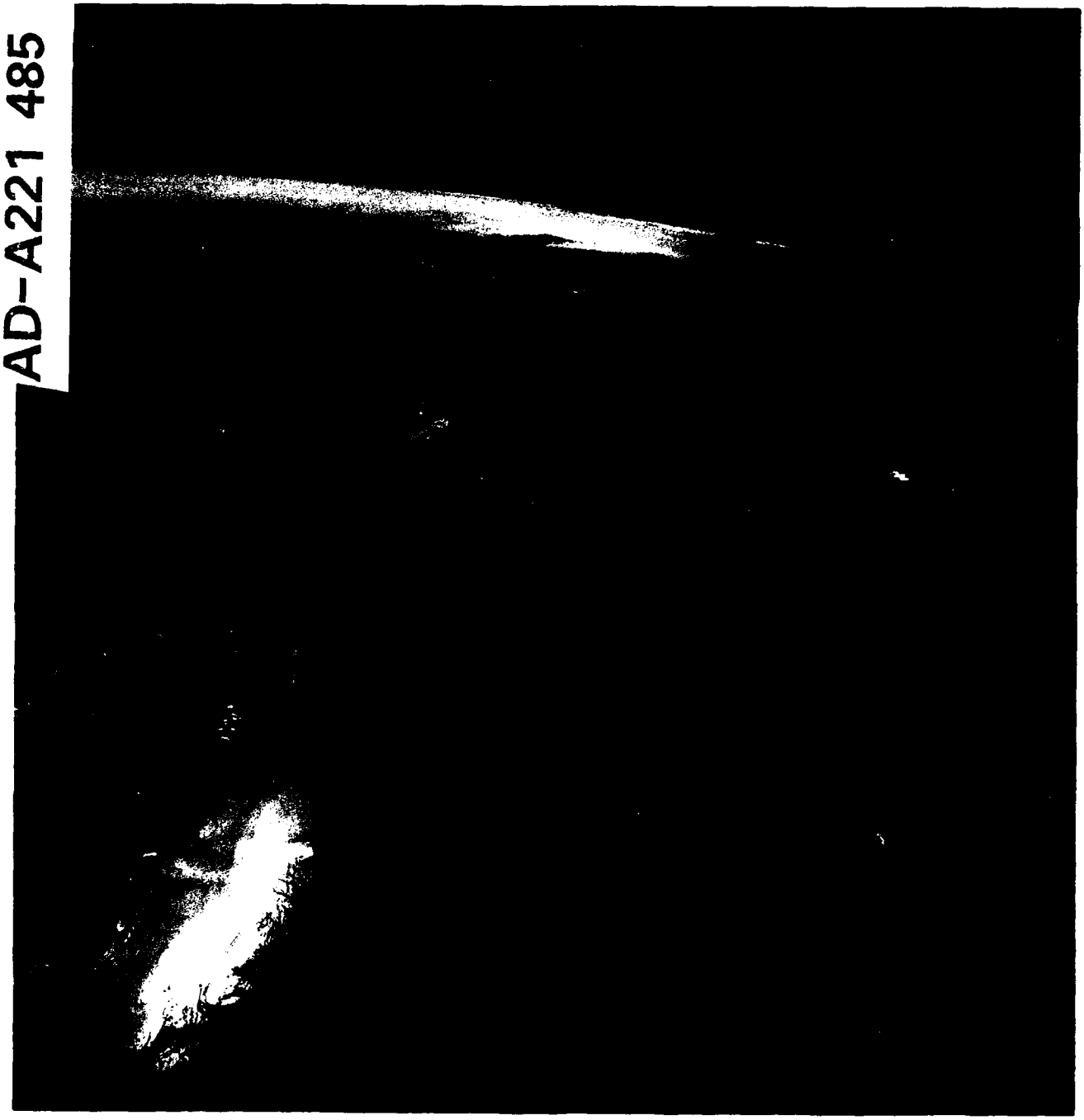

Plate 1. This shuttle photograph, taken as part of the preliminary study phases of the Western Mediterranean Circulation Experiment, displays a region of dynamic importance to the western Mediterranean circulation. Taken from an altitude of approximately 200 km, the photograph shows the African coast extending from Oran, Algeria, to the Strait of Gibraltar at 1313 UT on October 8, 1984. The variations in surface brightness in the lower portion of the photograph define the boundaries of the Algerian Current as it hugs the Algerian Coast. Further east (i.e., below and out of view of the bottom of the picture), the pattern of the current is not as direct, forming eddylike structures (but still remaining within 100 km of the coast). The specular, or solar reflection point, occurs at about 0° longitude and accents the boundary of the Algerian Current. The detailed brightness patterns are a response to the reflection of the sun off roughness changes in the sea surface.

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 95, NO. C2, PAGES 1511–1514, FEBRUARY 15, 1990

The Western Mediterranean Circulation Experiment (WMCE): Introduction

PAUL E. LA VIOLETTE

Naval Ocean and Atmospheric Research Laboratory, Stennis Space Center, Mississippi

1. General Description

The purpose of the Western Mediterranean Circulation Experiment was to study the circulation of the western Mediterranean Sea from the Strait of Sicily to the Strait of Gibraltar using scales ranging from basin-size to 1 km and depths from the surface to the deepest layers. An international consortium of multidisciplined marine investigators formed its study group; each had programs adapted to achieve the common goal: to derive the spatial and temporal variability of the western Mediterranean Sea circulation.

WMCE was a logical outgrowth of a number of field campaigns and data analyses (see, for example, *Donde Va? Group* [1984]) that raised as many questions as answers. The WMCE Consortium was formed during a 1983 NATO (North Atlantic Treaty Organization) study meeting in La Spezia, Italy, when the time and resources were judged appropriate for a study of the western Mediterranean as a single entity. Such a study would answer the following questions:

1. What are the major features of the western Mediterranean circulation, and how do they vary in space and time?
2. What are the physical forcing mechanisms?
3. How can this knowledge be implemented into numerical models?
4. How does the circulation affect the chemical, biological, and optical properties of the western Mediterranean Sea?

The field study began in November 1985 with the positioning of the first set of current meter moorings (Strait of Sicily and Corsican Channel) and an aircraft campaign (Straits of Sicily and Gibraltar and Algerian coast) (see Plate 1). The field period ended in March 1987 with the recovery of current meter moorings from along the Algerian coast. Figure 1 shows the location of the long-term moorings and generalized locations of the basins.

The field campaigns were run concurrently with two companion Mediterranean experiments: the Gibraltar Experiment [*Kinder and Bryden*, 1987] and Physical Oceanography of the Eastern Mediterranean (POEM) [*Malanotte-Rizzoli and Robinson*, 1988]. Although the three experiments were conducted independently, the major participants of each were aware of the others' field efforts. When possible, the field campaigns were made to complement one another, allowing a broader coverage of the Mediterranean circulation than would have been possible if the efforts were individually done.

In March 1988 the WMCE Symposium and Workshop was held at Bay St. Louis, Mississippi, hosted by what was then the Naval Ocean Research and Development Activity (now the Naval Ocean and Atmospheric Research Laboratory). Papers from this symposium as well as related papers are presented in this special section of the *Journal of Geophysical Research*.

Paper number 89JC03650.

2. Results

Because of the scarcity and spacing of ocean stations, early studies of the area presented a simple pattern of a wind-driven circulation [*Ovchinnikov*, 1966]. The WMCE studies in this volume indicate a more complex circulation, which is driven by a combination of factors and time scales. Although the major aspects of the circulation and its seasonal variability have been defined, there still remains a debate on the relative importance of the various forcing acting on the circulation (i.e., thermohaline, atmospheric pressure, wind stress, topography, and hydraulic exchanges through the straits of Gibraltar and Sicily).

A reading of the various studies will indicate that at all depths, the sea is extremely variable. In the lower layers the influence of the filling and emptying of the reservoirs of Western Mediterranean Deep Water (WMDW) and Levantine Intermediate Water (LIW), especially LIW, appears to be a crucial factor. Although the circulation of these deep water masses generally follows the topography of the various basins, they show wide variation in path and speed. In addition, the deep waters appear to be able to surmount the shallow intervening sills (including the Strait of Gibraltar). There is evidence that the rapid changes of the circulation rate of these water masses interact with the surface layer owing to both shear and buoyancy effects.

Most of the effects of the deepwater movement appear to be seasonal. The indication that the interface between surface water (Modified Atlantic Water or MAW) and LIW (Figure 2) is deep in winter and shallow in summer reflects changes in the volume of the deepwater reservoirs. There is a strong indication that the seasonal surface changes in circulation may stem partially from the seasonal volume change of the Mediterranean water reservoir.

3. Future Work

WMCE is but a start: there is still a great deal about the circulation of the western Mediterranean Sea that is still not known. In the 1990s, satellites will be orbited with suites of sensors whose diversity will be unparalleled by previously orbited systems. Incorporating the data available by these new suites of sensors with in situ measurements may well produce answers to some of the questions left unanswered by WMCE.

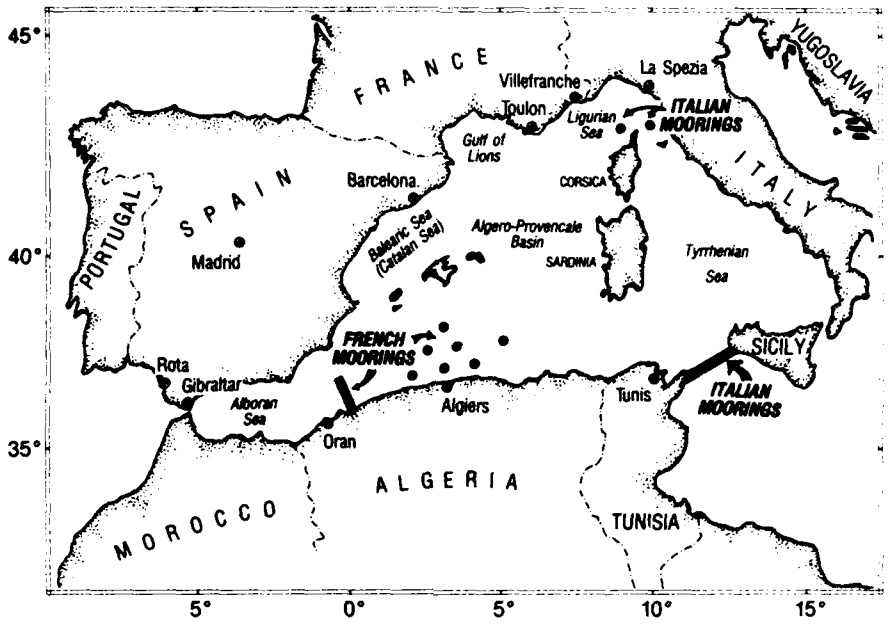

Fig. 1. Location of the WMCE long-term current moorings and generalized location of the western Mediterranean regional basins.

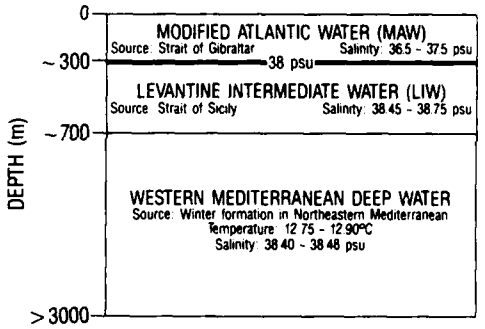

Fig. 2. The water masses in the western Mediterranean and their approximate location in the water column. In general, salinity of 38 psu can be used to mark the interface between the waters of mostly Atlantic origin and waters of Mediterranean origin.

REFERENCES

Donde Va? Group, Donde Va? An oceanographic experiment in the Alboran Sea, *Eos Trans. AGU*, 65(36), 682–683, 1984.

Kinder, T. H., and H. L. Bryden, The 1985–1986 Gibraltar Experiment: Data collection and preliminary results, *Eos Trans. AGU*, 68, 786–787, 793–795, 1987.

Malanotte-Rizzoli, P., and A. R. Robinson, POEM: Physical Oceanography of the Eastern Mediterranean, *Eos Trans. AGU*, 69(14), 194–198, 1988.

Ovchinnikov, I. M., Circulation in the surface and intermediate layers of the Mediterranean, *Oceanology*, Engl. Transl., 6, 48–59, 1966.

P. E. La Violette, Naval Ocean and Atmospheric Research Laboratory, Stennis Space Center, MS 39529

(Received October 31, 1989;
accepted December 5, 1989.)

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. Agency Use Only *(Leave blank).*	2. Report Date.	3. Report Type and Dates Covered.
	Feb 15, 1990	

4. Title and Subtitle.
The Western Mediterranean Circulation Experiment (WMCE)

5. Funding Numbers.
Program Element No. 61153N
Project No.
Task No.
Accession No. DN257017

6. Author(s).
Paul E. LaViolette

7. Performing Organization Name(s) and Address(es).
Naval Ocean and Atmospheric Research Laboratory
Stennis Space Center, MS 39529-5004

8. Performing Organization Report Number.
JA 321:019:90

9. Sponsoring/Monitoring Agency Name(s) and Address(es).
Naval Oceanographic and Atmospheric Research Laboratory
Stennis Space Center, MS 39529-5004

10. Sponsoring/Monitoring Agency Report Number.
JA 321:109:90

11. Supplementary Notes.

12a. Distribution/Availability Statement.
Approved for public release; distribution is unlimited.

12b. Distribution Code.

13. Abstract *(Maximum 200 words).*

14. Subject Terms.
(U) Remote Sensing; (U) Satellites; (U) Mediterranean

15. Number of Pages.
3

16. Price Code.

17. Security Classification of Report.	18. Security Classification of This Page.	19. Security Classification of Abstract.	20. Limitation of Abstract.
U	U	U	SAR